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REPORT

Bars to Jars: Bamboo Value Chains in Cameroon

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Abstract Bamboo is a well know and versatile material, which is a common sight across Cameroon's diverse ecosystems, from dry to humid tropical and Afromontane forests. Its numerous uses range from storage jars to decorating restaurant-bars, beehives to knives, fences, fodder, and fuel. Responding to the paucity of data on species and uses, the value chain for bamboo in Cameroon was analyzed. Based on 171 interviews and field observations, two African indigenous species (alpine *Yushania alpina* and savannah *Oxytenanthera abyssinica*) and exotic (*Bambusa vulgaris* spp.) bamboos were identified as most utilized. They were tracked from major production zones to final consumers. The ecological, socio-economic, institutional, and governance contexts and impacts are described and analyzed. Issues for research, conservation, and development are highlighted. These include the ambiguous regulatory status, the relationship between tenure and management, threats and conservation of African species and options to increase the sustainable livelihoods for stakeholders dependent upon bamboo.

Keywords Bamboo · Cameroon · Value chain · Governance · Sustainable · Livelihood

INTRODUCTION

The Forests of Cameroon

Cameroon is situated in the Congo Basin, the second largest intact dense tropical rainforest in the world. The high level of forest cover includes humid lowland, mountain cloud, and savannah forests, illustrating Africa "in miniature." These forests provide important economic, social, and ecosystem services and products, despite increasing pressure from agriculture, population growth, extractive, and plantation industries accelerating land-use changes (de Wasseige et al. 2009). Non-timber forest products (NTFPs), goods of biological origin from natural, modified, or managed forested landscapes, have long contributed to subsistence needs, providing energy, food, medicines, materials, tools, fodder, cosmetics, and cultural objects (Ingram et al. 2011). They are also traded, with the chain from forest to consumer set in a context of a predominantly rural population, low development, significant poverty and inequality, high corruption, and a difficult business operating environment, indicated in Table 1. Increasing data on NTFP trade has raised their prominence as policymakers realize their livelihood, social-cultural, and economic value.

Bamboo in Cameroon

Across Cameroon bamboo is a commonly seen NTFP, but data on it is sparse. Whilst one study exists on grasses (van der Zon 1992), knowledge of the taxonomy, distribution, and uses of bamboo are limited to four geographically specific botanic inventories (Hawkins and Brunt 1965; van Dijk 1999; Cheek et al. 2000a, b; Zapfack et al. 2001) and a only a handful of studies mention its uses (Lauber 1990; Gautier 1995, 1992; Knopfli 2001; Comiskey et al. 2003). Globally, bamboo is an important resource: meeting growing and diverse consumer demands for natural, environment-friendly products, and providing income and livelihoods particularly in developing countries, contributing to reforestation and climate change mitigation measures (Perez et al. 2004; Pabuayon 2009; Lobovikov et al. 2011). However, in Cameroon, quantitative and qualitative data on the role of bamboo in the livelihoods of users and those involved in its trade does not exist. Concerns about

Table 1 Development, forest, and governance indicators for Cameroon

Development	
Country classification[a]	Lower middle income
Population living below US$2/day[a]	44.1 %
Population density/km^2 (2008)[b] (2005)[c]	39
Urban population 1975[d]	26.9 %
Urban population 2010[a]	58.4 %
GDP per capita (US$ 2007 PPP)[a]	2979
GDP (US$ billions 2007 PPP)[a]	39.4
Overall HDI rank[a]	95
Forests	
Total forest area (ha)[e]	27 351 387
Forested landscapes (all types) %[e]	59
Annual net deforestation rate%	0.14
National[e]	1.00
Savanna[f]	0.40
Montane[g]	
Annual net forest degradation rate%	0.01
Public forest ownership[h]	86 %
Contribution forest exports to GDP (2008)	6 %
Timber fiscal export value (million $)[e]	85.5
Annual export/formal timber exploited (m^3 thousands)[i]	600 45 000
Employment export/formal timber market[i]	
Domestic timber market value (million $)[K]	58.0
Annual domestic timber exploited (m^3 thousands)[i]	900 38.5
NTFP market value (million $)[j]	350 000
Employment in NTFP market[j]	
Gov	
Inequality measure (Gini index)[a]	44.6
Ease of doing business[k]	168
Averaged rank Worldwide Governance Indicators[l]	19
Corruption[m,n]	146 and 44

Sources [a] UNDP Human Development Report 2009 (rank out of 182 countries), [b] United Nations World Prospects Report 2008, [c] Government of Cameroon, Population Census 2005 (2010), [d] UNDP Human Development Report 2005 (rank out of 177 countries), [e] de Wasseige et al. (2009), [f] UNDP/ARPEN (2006), [g] Solefack (2009), [h] MINFOF and FAO (2005), [i] Lescuyer et al. (2009), [j] Ingram (2011), [k] World Bank Doing Business 2011 (183 countries), [l] Transparency International Corruption Perception Index 2009 (180 countries), [m] Kaufmann et al. (2010) (average of 6 indicators, ranked out of 213 countries 1996–2009), [n] Mo Ibrahim Foundation (2010) (rank out of 53 countries)

unsustainable NTFP trade (Ingram et al. 2011) highlight the need to establish if these fears are applicable to bamboo, particularly as five species are Afro-endemics (Ohrnberger 1999; Bystriakova et al. 2002). Such baseline information is critical to inform policymakers and practitioners, and guide conservation and development interventions.

The objective of this study was to review bamboo use and trade in Cameroon, the sustainability of the value chain and how it is governed and provide recommendations for sustainable development of the chain.

CONCEPTUAL FRAMEWORK

Value chains provide the framework used to analyze the activities and processes involved at situation-specific geographical scales from harvest, production, transformation, processing to consumers (Kaplinsky and Morris 2000). Value chain analysis can be used to assess potentials to support pro-poor sustainable development (Lecup 2006). Territoriality is important as chain activities and flows are geographically situated with diverse impacts at different locations (Gereffi et al. 2005), influencing profits and perceptions of value (Rammohan and Sundaresan 2003). A holistic approach to value chains including socio-economic, cultural, and environmental values has been shown to be important (van Dorp et al. 1998). Consumer perception, historical, cultural, and religious significance and origin also influence value (Jensen 2009), as Sheil and Wunder (2002) point out, value is not an inherent property, but a measure of a relationship between a subject and the object of valuation, within a specific time frame and geographical context.

METHODS

A literature review was used to identify species, chain activities, policy and regulatory context, approximate numbers and types of actors, and locations for study. The second step, between September and November 2009, was to interview 22 stakeholders (from research, private sector, government, development, and conservation organizations) to further gather information about economic, social, and environmental aspects of the chain, verify data from the literature review, and identify the major production and market areas, and actors for interviews. Results were presented and verified at an "International workshop on Enhancing Opportunities for Market-Led Bamboo and Rattan-based Development in West and Central Africa" in Yaoundé from Nov 23 to 25, 2009, organized by the International Network for Bamboo and Rattan (INBAR), World Agroforestry Centre and Ministry of Forests and Wildlife (MINFOF). Between November 2009 and February 2010, semi-structured interviews were then held with 39 harvesters, 38 craftpersons, 31 retailers, and 41 consumers (selected randomly and based on availability and

willingness to be interviewed), and production areas and markets visited in the West, Northwest, Southwest, Littoral and Centre regions, shown in Fig. 1. Guided by questionnaires, the interviews solicited qualitative and quantitative information on the actor's characteristics, bamboo-related activities, use and trade volumes, income and expenses, social and cultural uses, environmental aspects, regulation and governance, and perceptions of potentials, opportunities and weaknesses in the sector. Data on species, uses and actor types were also gathered in East and Adamaoua regions. Given time and resource constraints, the sample allowed a broad geographical coverage and overview of the chains, covering an estimated 10–50 % of actors in each region at each stage of the chain. Fourth, during fieldwork observations were made in production areas and markets and photos and samples of bamboo and products were taken to identify species. These were subsequently verified with INBAR. Data was checked and entered into CSPro (Version 3.1), with bamboo-related incomes, expenses, uses, and volumes analyzed and descriptive frequencies and statistics analyzed using Excel.

Limitations of the methods used include the one-off nature of data collection, coverage of only main production areas, use of recall for income and production data, and small sample size. This means the data can be used as a baseline for the areas studied but cannot be extrapolated nationally and that income and production data should be seen as indicative.

RESULTS

Ecological Aspects, Species, Distribution, and Consumption Zones

Three bamboo species indigenous to Africa were found commonly used, shown in Fig. 2. Afro-alpine bamboo [*Yushania alpina* (K.Schum.) Lin] was found in the mountain forests of the Northwest, where is it is assessed as "rare" (Cheek et al. 2000a, b). Huxley (1932) stated that every high mountain in Africa has bamboo except Kilimanjaro. Mt Cameroon, however, has no bamboo, probably for similar reasons to those postulated by Grimshaw (1999) and Hemp (2006): porous soils, insufficient rainfall in the rain shadow, and frequent eruptions. No precise data on surface area or biomass exists; however, recent inventories (Foaham et al. 2009) indicate between 2000 and 4000 ha exist. Land-use changes since the mid-1960s (Hawkins and Brunt 1965) have resulted in diminished Alpine bamboo in Awing and the Bamboutous, and it is no longer found in Bali Ngemba or Dom (Harvey et al. 2004; Cheek et al. 2010). African savannah bamboo [*Oxytenanthera abyssinica* (A. Rich.) Munro] was found in lower altitude, riverine areas from Bertoua in the East to Ngoundal and Meiganga in Adamaoua up to Garoua in the Northern region. A *Guaduella* species was found in the savannah around Ngaoundal, with specialized use in making beehives. Smaller, grass-like rainforest bamboos such as *Puelia atractocarpa* Franchet and *Microbambus macrostachys* K. Schurmann ap. (Ohrnberger 1999) were not identified as commonly used and their range was subsequently not verified. In Adamaoua and the Northwest, both species were harvested from forest ecosystems where bamboo is still wild, with only one small, recent cultivation project found around Ngaoundal.

The dominant (91 %) species found used across Cameroon were exotics. The most common was *Bambusa vulgaris* Schrad., locally known as "Chinese," "Indian," or "large green" bamboo. Although found in remote areas mainly in former settlements, the major harvest zones were peri-urban areas, predominately along the major roads, rivers and streams, and adjacent to most major towns and cities throughout southern Cameroon. In the Southwest, large groves exist around Saker Point, the first colonial settlement and Limbe Botanic Garden, introduced by the Germans in the 1880s, used in banana plantations. It appears likely that the majority of *B. vulgaris* and subspecies originate from colonial introduction (Personal communication Marliac, CIRAD February 2010), with subsequent naturalization and anthropogenic dispersal. "Yellow bamboo" (*B. vulgaris* var. *vittata*), other smaller green *B. vulgaris* subspecies, *Ochlandtra travncoria* and naturalized bamboos resembling grasses (probably *Olyra latifolia* Linnaeus) were noted by 25 % of harvesters. Exotic bamboo is largely (57 %) naturally regenerating, 15 % has been planted (mainly the South, Center, Littoral, and West and recently in Adamaoua) and 28 % is a combination of natural generation and planting.

The main production areas (Fig. 2) mirror the distribution of endemic and exotic bamboos. The major and longest trade circuits flow from the production areas in southern Cameroon, particularly from Edea, Ebolowa, and Limbe to consumers in large cities of Douala and Yaoundé. There are also routes to the provincial capitals and large towns of Kribi, Buea, Ebolowa, and Bamenda, originating from nearby sources. No sub-regional or international trade was found.

Bamboo Chain Actors and Livelihoods

The chain is relatively simple and typical of market-based networks (ILO 2006). Illustrated in Fig. 3, the direct actors are owners, harvesters, processer craftpersons, wholesalers, and retailers (largely individuals or micro and small enterprises), with many mainly one-off customers with whom there are limited information flows. Formal regulatory, support, and control actors are largely absent;

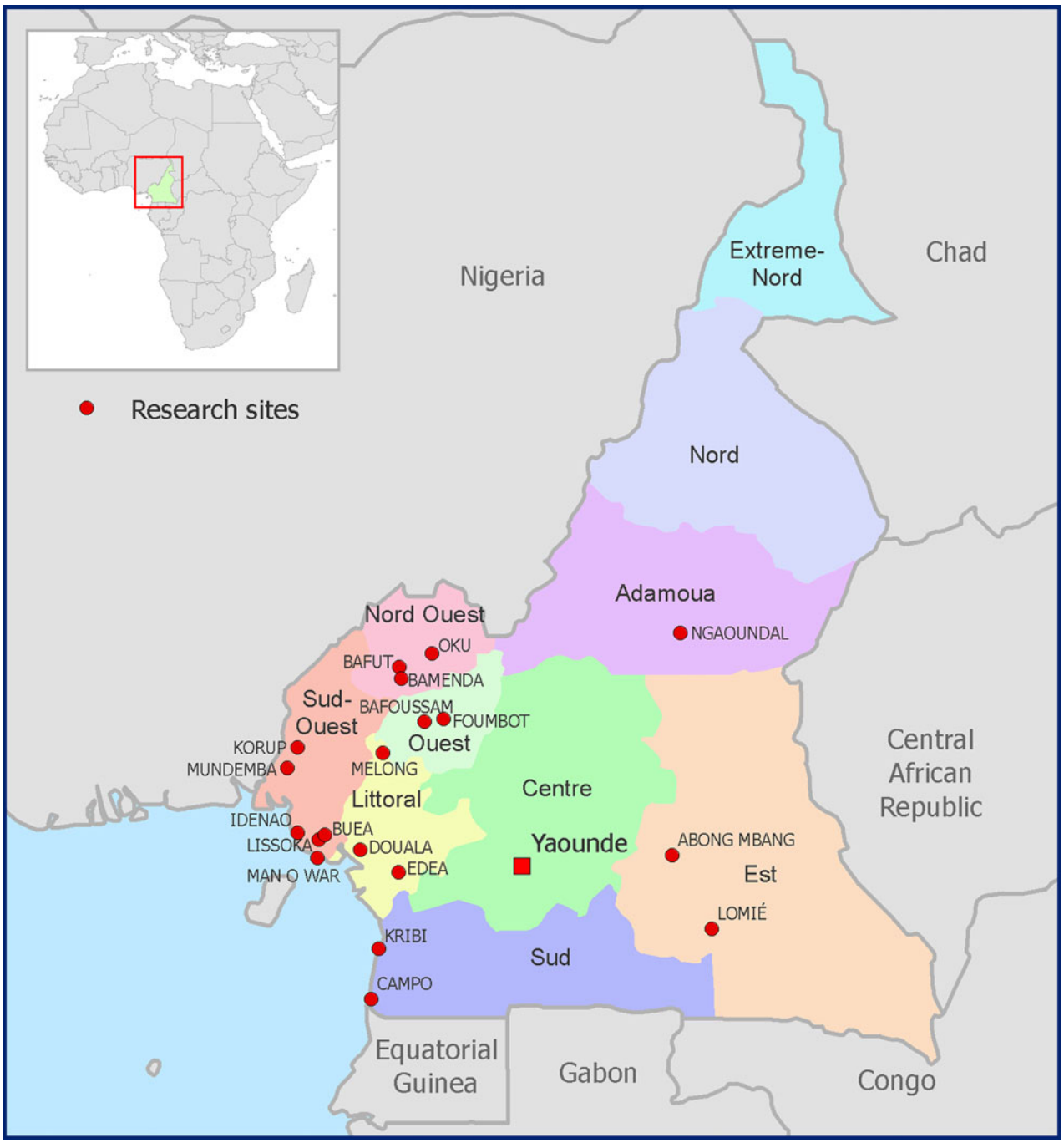

Fig. 1 Bamboo value chain study areas, Cameroon

although local council authorities control market retailers, and some traditional councils and chiefs regulate use locally. The Ministry of Small Scale and Medium Enterprises (MINSME) is stimulating crafts organizations, albeit not specific to bamboo. No actors providing development, technical processing, or bamboo agroforestry support were noted. Compared to other NTFPs, the bamboo chain is similar to the rattan in terms of actors and activities (Sunderland 2001).

Harvesters

Across the country, similar patterns were found with bamboo harvested and used directly by 77 % of harvesters.

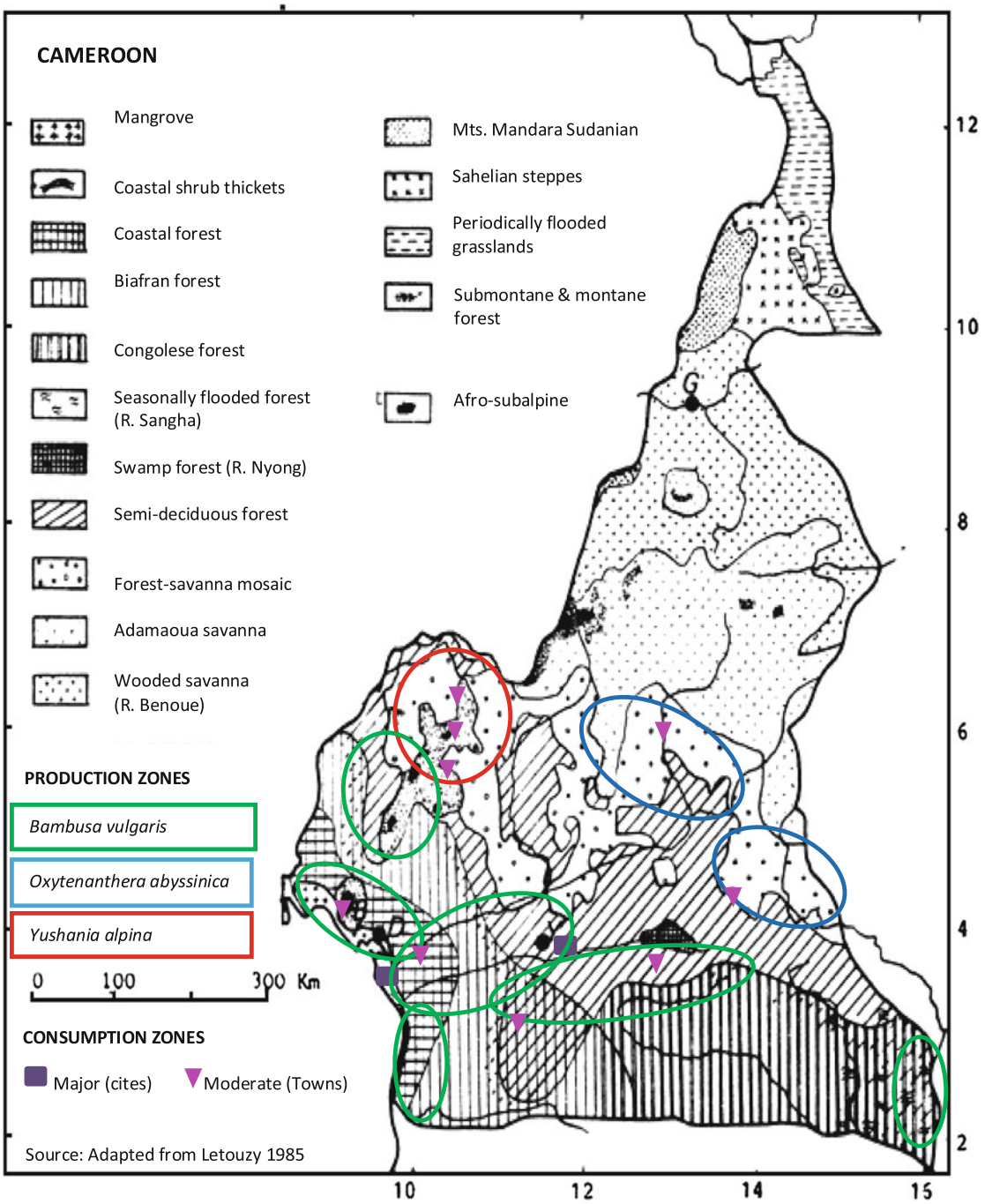

Fig. 2 Major production and consumption zones in Cameroon

These are typically middle-aged (44, SD 17), married family men (90 %) supporting a household of 6.7 people, originating from the collection area, all operating informally.[1] On average two male family members help the harvester. Collective action is not common, with 13 % belonging to a group concerned with bamboo, and these are mainly long-established, local ways of cooperating to promote and support business. Most (51 %) respondents reported harvesting year round, and 41 % in the dry season, with on average 8 months a year (SD 4.4) spent harvesting. Harvest trips, usually head-portering (85 %) poles and using machetes, on average 4 h a day (SD 2.7 h), travelling on average 3.23 km (SD 3.8). The poles are then dried

[1] Informal denotes commercial operations not registered as enterprises, or with the Chamber of Commerce or MINSME.

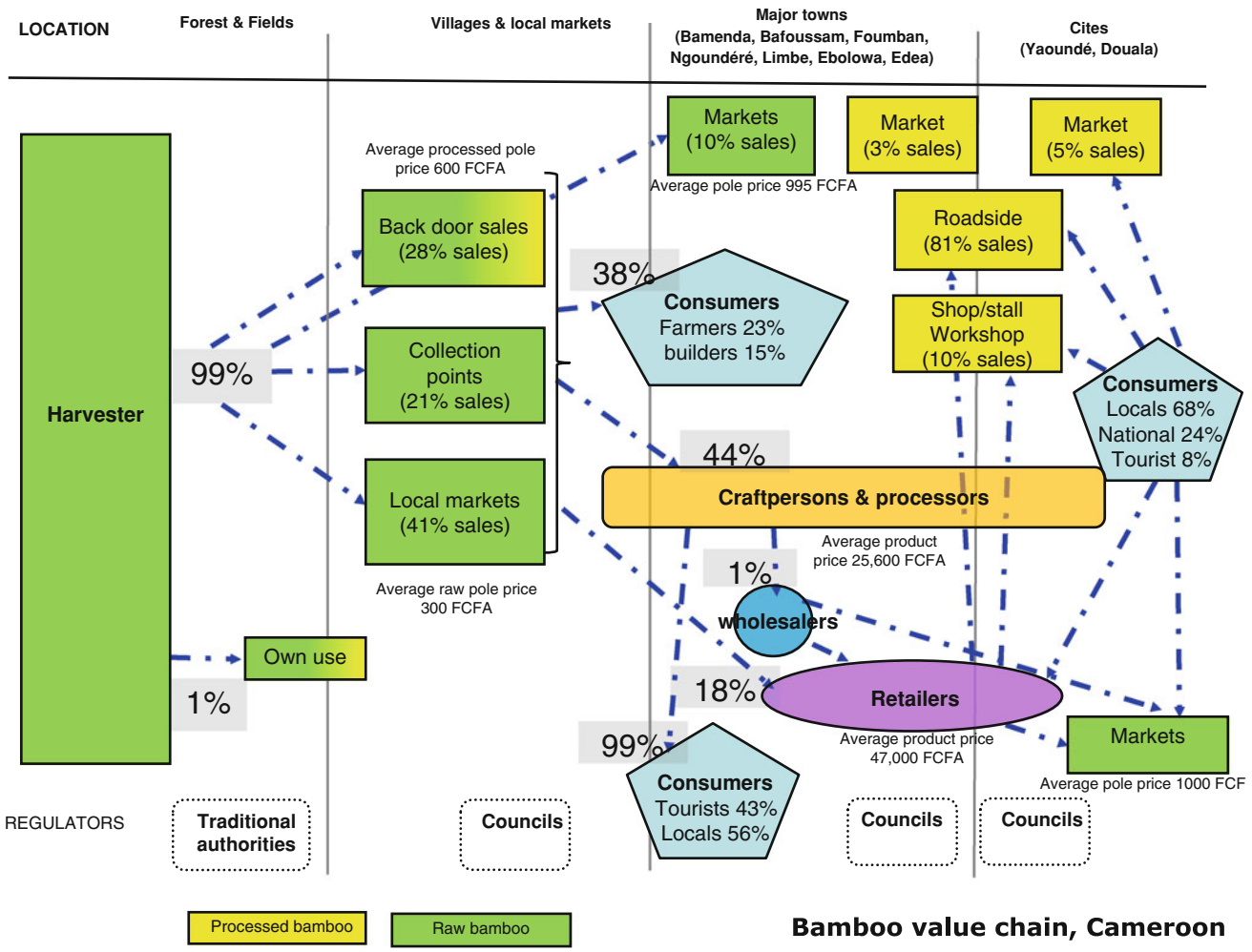

Fig. 3 Bamboo value chains in Cameroon

outside or under roof eaves. The quantity harvested depends upon accessibility (33 %), availability (23 %), and demand (18 %), with quality is judged by maturity (related to size and color) and resistance to rot and insects (both while growing and once harvested). 15 % of harvesters also process bamboo and although 77 % use small quantities (average 1 % of total collected) for their own household use with 80 % using for construction (huts, fences, yam props, and supports for plantain and bananas). The majority is sold to craftpersons (44 %), farmers (23 %), retailers (18 %), and builders (15 %), in local markets (41 %), from the collector's home (28 %), at collection points (21 %), or in urban markets (10 %). A small proportion of harvesters collect up to 6000 stems a year, but most operate smaller scale, collecting on average 600 stems annually (mainly *B. vulgaris* and *B. vulgaris vitatta*). Harvesters earn on average 236 208 CFAF annually (SD 467 712 CFAF) from bamboo, varying from 1625 to more than 2 million CFAF, contributing on average 36 % of household income. Bamboo is a secondary activity alongside farming with on average five, ranging up to nine, income sources, with a quarter of harvesters considering bamboo to be their major source of income. The income was used for basic needs: food (60 %), housing (21 %), school fees, clothing, and medical treatment.

Craftpersons

Craftpersons are largely married men, schooled to primary level, averaging 36 years of age, supporting a family of six, who have worked on average for 11 years with bamboo, ranging up to 30 years. Most use *B. vulgaris* to construct a range of products (Fig. 4), chiefly furniture, sold largely from the roadside or their workshops. Motivations for entering the sector include friends and family (23 %), inheritance (13 %), a lack of other opportunities (18 %), and purposively as apprentices (10 %) or due to a passion for the trade (28 %). Most work individually (76 %) and own their workshops and have apprentices (average 0.79 SD, 1.33 per craftsperson). The majority (87 %) work

1. Furniture (tables, stools, chairs, sofa, beds, shelves, cupboards, racks, hanging screens)
2. Fencing and hedges (live and cut poles)
3. Construction material (poles, house supports, doors, scaffolding, roofing, ceilings, wall cladding, TV aerial/antenna masts)
4. Utensils (combs, drying racks, smoking racks [for fish and *Irvingia* spp.], cups, containers, soya sticks, small tools and handles)
5. Baskets and containers (food containers, flower pots, beehives)
6. Hunting implements (spears, traps, cages, bow and arrows)
7. Agriculture supports (beans, bananas and rubber)
8. Water pipes/conduits
9. Musical instruments (whistles, flutes, rattles, wind chimes)
10. Ornamental and decorative planting
11. Fuelwood
12. Paper
13. Forage (notably pollen for bees and leaves for elephants)

Fig. 4 Bamboo products produced in Cameroon

informally (see Footnote 1). One-third belongs to an association, mainly of craftpersons (83 %), while 17 % were vertically integrated in groups including harvesters. The oldest originated in 1985 and half were created in 2009, particularly around Douala following campaigns by MINSME. The stated benefits of collective action were the exchange of ideas and experiences and training. A craftsperson's average gross income from bamboo was 50 % higher for those in groups, whilst the average quantity of bamboo purchased was identical and purchasing costs 20 % higher. Craftpersons tend to source and sell locally, earning an annual household income of 445 361 FCFA (SD 412 501) from bamboo. Although having up to five sources of revenue, bamboo was the primary activity for the majority, contributing to 90 % of household income on average, with farming second.

Processing technologies are basic, consisting first of primary cutting and air-drying, during which infestation and rot is a problem, with 60 % reporting losses. Secondary processing transforms poles into products by crafting, burning, carving, cutting, fabrication, lacquering and, in the most complex process encountered, in Oku, into paper. On average three product types were produced. Thirteen product types, comprising 44 products were found in total (Fig. 4). Bamboo was often combined with wood, rattan, and metal but not consumed as a foodstuff, unlike in Asia and Uganda (EFTRN 2003). Oku has the longest recorded history of bamboo use (Kaberry 1952) and widest range of products. Exotic bamboo species were used by 91 % of craftpersons, primarily for construction, furniture, tools, and containers, with other species having specialized use in containers and furniture (Figs. 5, 6).

Sellers

Just over half of sellers (56 %) vend unprocessed poles (of which 78 % are retailers, 17 % middlemen, and 5 % wholesalers) and 44 % sell processed products [comprised of retailers (92 %) and wholesalers (8 %)]. Two-thirds work alone with one family member occasionally helping and a third belong to a bamboo and rattan crafts association. The majority (90 %) lives in urban areas and are typically married, middle-aged men (93 %) with primary schooling, native to the area of commerce, heading a household of on average five people. Bamboo sales are the major occupation for 32 %. Other income sources are agriculture and unskilled laboring. Bamboo provides on average 300 000–1 200 000 CFAF, on average 709 000 CFAF, contributing to 75 % of household annual income. No significant differences were found between locations. Sales are largely to local clients (77 %), mostly from roadside sales with on-the-spot, negotiated prices. Prices reflect demand, quantity of raw material used and product quality.

Consumers

Bamboo is purchased across Cameroon in villages and urban areas with no regional differences found. It is used for construction (50 %), furniture (30 %), agriculture (22 %), tools and utensils (21 %), and as fuel (12 %). Consumers perceive it as cheap—in comparison to other materials for equivalent products—but producing high quality goods. Bamboo products, however, perceived have a low durability and are easily substitutable with other materials. Consumers responded positively to the idea of new and different bamboo-based products. As well as being marketed, a small number of products (10 %) such as ceremonial spears, whistles, and poles used in traditional meeting houses and palaces, particularly in the Northwest and Southwest, were reported by stakeholders, actors, and consumers and observed as having cultural value.

Harvesters reported problems of injuries, low demand, product deterioration, long harvest-to-market distances, transport and processors concerning low profits and demand, poor transport and tools, product deterioration, and consumer's lack of awareness of bamboo products. Respondents indicated that opportunities and actions to

Fig. 5 *Bambusa vulgaris* clad cafe-bar and furniture, Buea, Southwest (Photographer: Julius Chupezi Tieguhong)

develop the sector included improved product marketing and showrooms; introducing grading standards; increasing consumer awareness of the range and quality bamboo products; improving crafts and marketing skills though training, exchanges and associations; and planting more bamboo.

Governance Aspects

Ownership of bamboo did not vary significantly by region. Nearly, a third of harvesters own bamboo stands (varying from 1 to 20 ha, average 9.25, SD 4.99) which are close to home, on average 3.23 km (SD 3.83). Ownership and access to tree and agricultural resources is often separated from land ownership in Cameroon (Goheen 1996). When asked who controlled or owned land that bamboo was found upon, 62 % of harvesters indicated a landowner, 24 % a chief or community and customarily owned and governed, and 8 % was not owned and open access. Access and control rights vary significantly between regions. On average 56 % of harvests are regulated with villagers having rights to harvest, and 43 % of harvests are open to anyone. In Adamaoua, Southwest, Northwest, and West regions access rules were more detailed, for example, in Oku, a 1993 Prefectural Order included a prohibition on cutting young bamboo in the Kilum–Ijim forest. When this lapsed, rules were jointly developed by traditional chiefs and a conservation project that only mature or dry bamboo could be cut, and if young bamboo were needed, the community must be consulted. In Djerem, outsiders need permission from villagers, and in the Southwest one-third of harvesters indicated that harvesting is free but the landowner's verbal authorization is needed. In 33 % of cases, where permission was needed, payment was made to traditional or village authorities. Local practices governing harvesting include allowing only experienced harvesters and, in customarily managed areas, only upon authority of the chief. None of the harvesters reported encountering formal regulation or government control.

Bamboo is not formally regulated. It is not specifically mentioned in the 1994 Forestry Law, 1996 Framework Environmental Law, as a Special Forestry Product (SFP) (Decision No. 0336 of 2006) or in the annual SFP lists. The 1994 Law acknowledges customary user rights of forest

Fig. 6 Market retailer with *Y. alpina* storage jars, Oku, Northwest (Photographer: Verina Ingram)

products, allowing communities to collect forest products (except protected species) freely for personal use in unprotected areas. No inventory has been conducted (Article 40) and bamboo has not been marked for conservation or regeneration in concession areas (Article 43). The 1974 Land Ordinance states that planted trees belong to the land owner, but naturally growing trees on private land and all trees planted or naturally growing on land without a title deed are considered state property. Interviews with MINFOF and the National Office of Reforestation (ANAFOR) indicate that policy priority is given to timber, with NTFPs assumed as low value, leading to their largely being unregulated. MINFOF and stakeholders are currently revising the 1994 Law, although the bamboo sector has not been involved. MINFOF indicated that it is reviewing the classification of bamboo (as a tree or grass, and as a timber or non-timber product), user rights and commercialization and the vulnerability levels of indigenous species.

DISCUSSION

Traditional Governance and a Policy and Regulatory Void

How the chain is regulated and the rules of the game determine access and control, opportunities and constraints (Larson and Ribot 2007). Formal law is only one aspect of governance, but despite forests being largely state property, in practice, bamboo is governed by a mix of common and customary private property rights and rules, there is a regulatory void and the government is largely absent. Bamboo is an "invisible product": not mentioned in forest or agricultural regulatory frameworks. To date, the lack of policy and legislation has neither directly hindered nor supported the trade. Secure tenure and regulation of access and control have been shown to be important for sustainable exploitation (Barry and Meinzen-Dick 2008). In the bamboo chain, the high level of customary bamboo and land ownership, and customary regulations governing rights of access and exploitation, have provided security and control over the resource to date. The bamboo chain is thus similar to other historically long-existing NTFPs chains based on highly cultivated and managed species, such as *Raphia* spp., *Cola* spp., and Gum arabic (*Acacia* spp.), and in contrast to lower (on average 30 %) customary ownership of NTFPs such as *Gnetum* spp., *Prunus africana*, and *Irvingia* spp.

Given the largely local and small level of trade and own consumption of exotic bamboo species, and little evidence of vulnerability from over-harvesting, formal regulation also appears unnecessary in the current regulatory context, as long as exotic species are used, harvest volumes and trade value remains low (compared to other non-timber and timber products). Endemic species, however, appear more vulnerable due to limited resource availability and high levels of anthropogenic induced threat. Different governance arrangements to manage and conserve these species may be needed if resources appear to be declining (which is anticipated for alpine and savannah bamboo) or over-exploited. If the sector increases in value and/or becomes a focus of regulation or policymaking, as appears likely, the contradiction between the legal position of state owned planted and naturally growing trees and customary ownership may create contestations over ownership. Overlapping customary and regulatory regimes, such as occurred in Kilum–Ijim, can confuse access rights and make balancing conservation, development, government revenue, and local income generation objectives challenging unless both

specifically work toward the same objective (Laird et al. 2010).

Livelihood Importance for Chain Actors

The governance arrangements described impact livelihoods, determining which actors control a value chain, the value gained and distribution of costs and benefits (Ribot 2005). The number of direct chain actors (including apprentices and family laborers) is estimated at between 1223 and 5540 people in the areas studied. The majority are male, supporting on average a household of 5.75 people, thus ~31 000 people benefit from bamboo-related incomes. Whilst this is a small number compared with other NTFPs (Ingram 2011), and appears related to the geographically specific availability of bamboo, the bamboo sector provides almost as much employment as the formal timber sector in Cameroon. The heavily male-dominated bamboo chain is in contrast to other NTFP chains, where on average 59 % are male (Ingram 2011), reflecting the physical labor required to harvest, transport, and process. Dependency upon bamboo varies, with harvesters having the most diversified incomes and bamboo forming a lower proportion of total income. Nonetheless, comprising a third of harvesters' income, bamboo contributes double that of NTFPs in the Southwest (Ambrose-Oji 2003). Craftspersons are most reliant, with bamboo forming the major proportion of income, reflecting their high specialization and investment in the trade. Bamboo, in common with many NTFPs worldwide (Ros-Tonen and Wiersum 2003) and in the Congo Basin (Ingram 2011), is rarely the sole source of income even for the most dependent, forming just one of a consciously diversified range of livelihood capitals. Paradoxically, those furthest from the source are less involved in its management, but are most dependent, a characteristic common in chains with little information exchange (ILO 2006). The different dependencies of actor groups signal that a chain-wide approach is essential to ensure equity in interventions and that one group is not unduly disadvantaged.

The choice to harvest and trade bamboo is largely driven by training and skills, and access to bamboo, markets, starting capital, and supportive social networks. A smaller proportion of actors turn opportunistically to bamboo when other income sources are lacking. Bamboo has low opportunity costs for actors once in the chain, who easily switch between bamboo-related and seasonal activities such as farming and occasional income sources when opportunities arise. That the majority of actors had been active for a decade and take professional pride in working with a difficult material, indicates their long-term investment in the sector and a stable market. Such behavior is in contrast to boom and bust trade in NTFPs such as *Funtamia elastica* (Geschiere 2007), and opportunistically traded NTFPs such as *Gnetum* spp. and *P. africana* (Ingram 2011). Formal support institutions and regulations have had scant influence on the chain. For the direct actors, bamboo was most prized for its economic value as commercialized it provides cash to meet basic needs. For consumers it provides low cost, good quality products, and wide range of products meeting subsistence needs. In specific areas in the Northwest and Southwest bamboo has a high cultural value. Its environmental value was mentioned only by indirect research and conservation stakeholders. In common with higher value chains (Humphrey and Schmitz 2001; ILO 2006), actors add value by processing, reflected in ownership of individual clumps and customary regulation of access. The value is currently, however, not sufficiently high that political and economic elites have attempted appropriation. The growing policy interest should be regarded with caution if control is taken from the current actors (Dove 1993), or optimistically as empowering actors and improving their livelihoods.

Despite at least 30 years of construction use (Mundi 1978) and over 60 years using Alpine bamboo (Kaberry 1952), the array of products produced (Fig. 4) is narrow compared with Asia. Exemplified by China, this may be due to the longer production history and well-developed and diversified processing industry (Perez et al. 2004). In contrast to other highly commercialized NTFPs in Cameroon (Ingram 2011), over half of bamboo harvesters manage their resource carefully, with most owned by the harvester. They are aided by being located close to a relatively small but abundant resource that regenerates easily, and is low cost to manage and relatively easy to harvest with widely available tools. Figure 7 shows how the average income of actors in the bamboo chain compares to seven other Cameroonian NTFP chains. Harvesters earn on average 5 % less than NTFP harvesters. This may be explained by the relatively low unit value of unprocessed bamboo poles compared to other NTFPs. Bamboo craftpersons earn 25 % higher gross incomes on average than other NTFP processors. This can be explained by the higher level of skill involved in processing, which adds more value to the end product. Retailers earned comparable annual incomes (1 % more) to other NTFP retailers. However, bamboo does not make actors any richer than an average Cameroonian[2] or allow them to rise significantly above a $2-a-day poverty baseline (equivalent to 321 930 FCFA annually). Thus, while bamboo contributes considerably to livelihoods, providing and diversifying income,

[2] Current income data for Cameroon is lacking (International Monetary Fund 2008). 1988 data indicates average household incomes of 152 000 FCFA, varying from 454 000 in Yaoundé, 380 000 in Douala, 160 600 in peri-urban areas in the south and 104 200 FCFA for a household of 6–9 people (Lynch 1991).

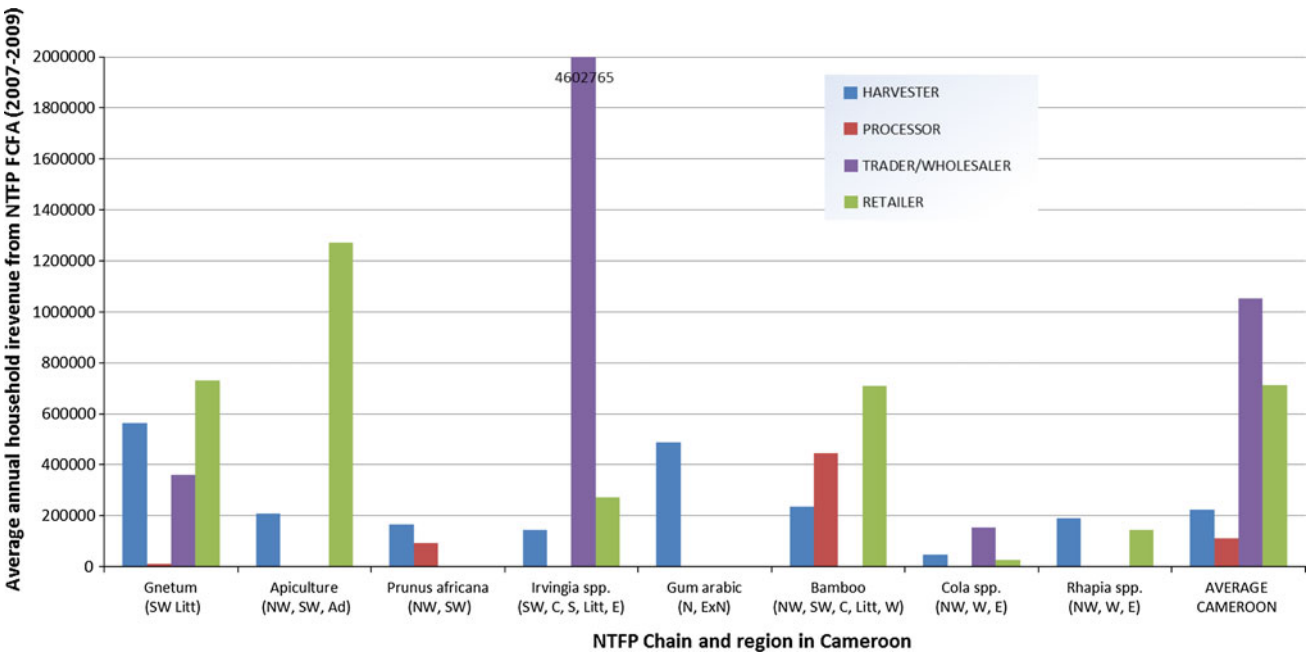

Fig. 7 Comparison of actor's incomes from NTFPs in Cameroon

and is used for subsistence, it is not a pathway out of poverty. Harvesters and craftpersons incomes' remain low.

Collective action in the form of groups and associations is low and focuses on economies of production scale as joint sourcing. Membership and the number of groups have grown as benefits become apparent, with the income data indicating that the economic benefits for those in groups are higher. This confirms studies (Mwangi et al. 2007) linking group membership to higher profits as empowerment allows control to be asserted. Although collective action enables group purchases, it plays no role in regulating access, although this has been shown to increase the likelihood of managing forest commons sustainably (Rustagi et al. 2010).

Conservation and Sustainable Harvesting

Although neither of the two African bamboo species is listed as endangered, vulnerability needs to be assessed given high deforestation and degradation rates in the Northwest and Adamaoua, the fragility of mountain species in heavily populated areas (Doumenge et al. 1993) and increasing fires by hunters, pastoralists, and agriculturalists around Mt Oku, causing substantial changes in forest ecology (Solefack 2009). *B. vulgaris* was found extensively grazed and a preferred species by elephants in the East (Conservator Lobeke National Park, Personal communication), indicating its availability may be important for successful eco-tourism and wildlife conservation. Currently, local market prices do not reflect the variety of uses, scarcity, and demand for different bamboo species. These factors, if combined with increased harvesting, could increase the vulnerability of *Y. alpina* and *O. abyssinica*. An element of species conservation is a resource inventory of the main production areas, although sustainable harvest levels may be difficult to assess (EFTRN 2003). In the absence of formal law, continued customary regulation is important in ensuring sustainable harvesting of these endemic species. Management is equally critical as bamboo can be an aggressive invader, replacing local species, and creating less biodiverse monocultures (Kleinn et al. 2006; Malin and Boehland 2006).

Given current demand and abundant resources, supply of exotic species is not an issue. However, if the sector is promoted and demand increases, regeneration, cultivation or domestication, and sustainable, long-term supply and management harvesting and management need to occur in parallel. As bamboo is easily grown, cultivation can be a feasible, low cost route. A route proven successful for other NTFPs in Cameroon has been the dissemination of germplasm and training harvesters, owners and farmers in cultivation, nursery and propagation techniques (Leakey and Tchoundjeu 1999). Appropriate new species with properties better suited to current (and potential) products and ecological zones in Cameroon could aid diversification and increase value, but needs careful research. As just under half of bamboo harvested is open access, land tenure, and ownership of bamboo clumps is an issue in sustainable supply. Ideally, tenure is secure and access regulated, but this may be difficult given ongoing debates and irresolution of competing customary and administrative tenure claims since the 1970s (Laird et al. 2010).

Sustainable Development

Developing the chain to increase employment and incomes appears feasible, taking a chain-wide approach to ensure that supply matches demand increases. Given the one-off nature and limited sample size, a fuller baseline study and value chain analysis could inform actors and focus on the weakest links and problems identified. Asian experiences (Perez et al. 2004; Pabuayon 2009) indicate that new products and designs, appropriate materials and processing innovations could help diversify incomes and add value to increase the prestige and durability of bamboo products. Discussions during the 2009 INBAR workshop and the study findings indicate that chain interventions could focus on selecting and planting suitable multiple-use species; increasing consumer and craftsperson's awareness of species properties and uses; professionalization and training in harvesting, processing, and business skills; and addressing problem areas indicated by actors, particularly storage. Given the positive consumer attitudes, targeted marketing, particularly in lucrative urban markets, could create new and larger markets.

The enabling environment is positive in terms of potential partner organizations, despite current non-involvement in the sector, as MINFOF and MINSME have displayed interest. Funding and development partners potentially include those interested in artisanal crafts, building materials, biofuels, renewable energy, reforestation, carbon sequestration and rural development, and for native bamboos: forest and conservation organizations. Public–private partnership, pilot models, and investment by craftsperson could provide a sectorial boost. In common with the NTFP sector in Cameroon, the majority of actors operate informally and are unorganized. Professionalizing the sector (building capacities in design, production, and business skills) and encouraging collective action could address needs for capital, advocacy, and marketing and enhance benefits. The costs and benefits of collective action in NTFP chains in Nigeria offer useful lessons (Laird et al. 2010). However, formalization of the chain in the context of the weak business operating environment, high corruption, and uncertain law enforcement could have a negative impact on the livelihoods of actors and access to the resource. Policies and development interventions that build on customary regulations, traditional knowledge, skills and voices need to be coordinated to produce a positive, sustainable livelihood impact. As bamboo is both planted and wild, liaison between the Ministries of Forests and Wildlife, Agriculture and Rural Development, farmer's and trader's associations is essential to promote cultivation, secure tenure, and ensure access. Bamboo's ecological characteristics could be positively used to combat soil erosion and capture carbon (Lobovikov et al. 2011), particularly on degraded and eroded land such as in the West, Northwest, and Adamaoua, and as part of Reduced Emission from Degradation and Deforestation (REDD) projects.

CONCLUSION

The many and varied bamboo products, ranging from musical instruments, construction material in houses and bars, to traditional storage jars, are derived largely from exotic bamboo species. These have maintained mainly local, informal markets in Cameroon for decades, produced largely by skilled craftpersons using basic processing and marketing techniques. The trade contributes significantly to the livelihoods of between 8000 and 31 000 people. Processers and traders are the most dependent on bamboo: it forms an important source of cash income used largely used to meet basic needs. This important but policy-invisible NTFP could have a greater livelihood impact: however, regulations, professionalization, and formalization need to be carefully implemented to avoid inhibiting the largely informal trade, adversely affecting profits, and sustainability of the resource. The common but small-scale commerce and current abundance, combined with semi-domesticated status of a largely exotic resource does not currently pose a conservation or supply problem. However, for native Alpine bamboo and savannah bamboo species, high forest degradation and deforestation rates may make these species vulnerable given any increase in demand. Integrated conservation and development actions, accompanied by research, could enhance the socio-economic impacts for those engaged in the value chain, and the ecological status.

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